

pedunculata erecta; involucri ca. 5-seriati gradati 10 mm alti phyllaria extima lanceolata acuminata interiora oblongo-obovata acuta v. acuminata, omnia basi indurata apice herbacea appressa v. extima parum laxa; achenia valde costata subglabra, pappo nullo.

Bush 0.3–0.6 m high, with numerous erectish branches, resinous-scented; stem with grayish-brown fissured bark, densely hirtellous with very short thick white hairs, more or less glabrate; branches normally simple, very slender, brown, striate-angulate, pubescent like the stem but only sparsely and irregularly so, often nearly glabrous above; internodes mostly 6–10 mm long on lower part of branches, 1.8–3.5 cm long above; leaves oblanceolate or the larger obovate, often with fascicles or short branchlets in their axils, 1.8–3.3 cm long, 3–10 mm wide, coriaceous, slightly resinous, plane, light green both sides, inconspicuously pubescent like the stem, narrowed into a petioliform margined base, loosely somewhat impressed-reticulate, subulately callos-tipped; peduncles slender, 3–5 cm long, naked or 1-bracteate, not thickened below the head; disk campanulate or campanulate-hemispheric, 12–13 mm high, 8–13 mm thick (as pressed); outermost phyllaries lanceolate, 4.5–6 mm long, about 1.5 mm wide, acuminate, sparsely and obscurely hirtellous, with short pale indu-

rated base and much longer appressed or loosely erectish herbaceous tip, the middle ones oblong or lance-oblong, about 2.5 mm wide, ciliate, many-vittate, the inmost obovate-oblong, acute, with short herbaceous tip; pales rather narrowly cuneate-spatulate when flattened out, acute or obtuse, apiculate, 10–11.5 mm long, slightly hirsutulous on back and obscurely ciliate at tip, about 5-vittate, subscarious with greenish tip; disk corollas golden-yellow, resinous-granular on the teeth, 7.5–8.3 mm long (tube 1.5–1.8 mm, throat subcylindric, 5–5.5 mm, teeth ovate, obtusish, 1 mm long); achenes obovoid, plump, strongly 5–6-ribbed and with 1 or 2 usually weaker ribs between each pair of strong ribs, resinous, obscurely puberulous between the ribs above, not ciliate, epappose, 4.8–5.5 mm long, 2–2.5 mm wide.

MEXICO: Rocky flats and slopes, top of grade at Cuesta de Zozaya (along road from Ocampo west over the mountains to Puertecito via Cuesta de Zozaya), Coahuila, September 20, 1941, *I. M. Johnston* 9289 (TYPE, Gray Herb.; photograph and fragment, herb. U. S. Nat. Arboretum).

Nearest *Flourensia cernua* DC. but very distinct in its narrower, mostly oblanceolate leaves, its larger erect heads solitary at the tips of the branches, and its obovoid, strongly ribbed, subglabrous, epappose achenes.

MYCOLOGY.—*Some Cuban Phycomycetes*.<sup>1</sup> F. K. SPARROW,<sup>2</sup> University of Michigan.

When we consider the luxuriance and diversity of the phanerogamic flora of the Tropics, it is not surprising to find as our knowledge of the soil microflora of this region is increased that here, too, is a rich area awaiting intensive study. The fungi herein

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Slides of the new forms are in the writer's collections.

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described were obtained from the provinces of Las Villas (Santa Clara) and Matanzas in central Cuba. With one exception they were all collected by the author from extremely dry soil during a prolonged period of drought. In addition to these fungi a number of other already described species were found. These will be discussed in another, more extensive paper. The methods of isolation employed are similar to those used by other workers in this field (Couch, 1939, et al.) and need not be repeated here.

*Phlyctorhiza peltata*, sp. nov.

Thallus unicentricus, raro multicentricus, superficialis in exuviis anguis, et ceteris; rhizoideis varie ex thallo orientibus, diametro  $3\mu$  (vel minus) ad originem, sursum angustatis et modice ramo-



FIGS. 1-14.—1, 2, Monocentric thalli of *Phylctorhiza peltata*, sp. nov.; 3, discharging sporangium of same; 4, polycentric thallus of *P. peltata*; 5, nearly mature sporangium showing discharge papilla; 6, discharging sporangium at higher magnification ( $\times 650$ ); 7, thallus of *P. peltata*. 8-14, *Aphanodictyon papillatum* Huneycutt: 8, portion of thallus bearing zoosporangia (a, zoospores in process of leaving cysts); 9, portion of thallus bearing sporangia of different shapes (a, one in process of formation); 10, young oogonium with encircling androgynous antheridial branches; 11, more mature sexual apparatus, the oogonium bearing two eggs; 12, oogonium with one androgynous and one declinous antheridium; 13, old oogonium bearing mature oospores; 14, germinated oospore with germ tube bearing a single sporangium. (Figs. 1-3, 5, 7,  $\times 330$ ; Figs. 4, 6, 8-14,  $\times 650$ .)

sis. Zoosporangia irregularia, longe peltata, 15–28 $\mu$  longitudinaliter et 5–8 $\mu$  transverse metentia, maturitate papillam singulam formantia demum a deliquescentia in porum sessile diametro 5 $\mu$  transformantem. Zoosporae ovoideae 4 $\mu$  longae, 2 $\mu$  crassae, globulo refractivo et flagello postico ad apicem corporis angustiore affixo praeditae. Sporae durantes non observatae.

Saprophytum in anguis exuviis ex rivulo prope Sanctam Claram in provincia "Las Villas," Cuba, 24 Mar., 1949.

Thallus monocentric, rarely polycentric, resting on the surface of the substratum; rhizoids arising from several places on the thallus, 3 $\mu$  or less in diameter at point of origin, tapering and moderately branched distally. Zoosporangia irregularly and elongately peltate, 15–28 $\mu$  along the long axis, 5–12 $\mu$  along the shortest; at maturity forming a single papilla, which at maturity deliquesces to form a sessile exit pore 5 $\mu$  in diameter. Zoospores ovoid, 4 by 2 $\mu$ , with a minute refractive droplet and a long posterior flagellum attached to the narrower end of the body. Resting spores not observed.

Saprophytic on snakeskin in stream 5 miles west of Santa Clara, Las Villas Province, Cuba; March 24, 1949.

The species differs strikingly from *Phlyctorhiza endogena* Hanson and *P. variabilis* Karling in the peltate, irregular (never spherical) shape of the sporangium and sessile exit pore (Figs. 1–7). Other, less conspicuous features also separate it from the aforementioned forms.

*Nowakowskiella atkinsii*, sp. nov.

Thallus patens, multiramis paucas tumiditates irregulares ferens etiamque raro partes (functionis ignotae) magnas setigeras 1- vel 2-cellulares turbinatas. Sporangia terminalia in apicibus ramis plus minusve elongatis vel raro intercalaria, saepissime sphaerica, raro subpyriformia, diametro 13–20 $\mu$ , saepe apophysata; membrana paucas setas flexuosas 9–16 $\mu$  longas ferente. Zoosporae subovoideae 5 $\mu$  longae, 3 $\mu$  crassae, globulo singulo et flagello postico praeditae, per porum lateralem vel subbasalem dehiscencia operculi 8 $\mu$  diametentis emergentes, primum ante motilitatem exhibentes compacte aggregatae. Sporae durantes ignotae.

Saprophytum in substantis artificiali cellophanum dicta ex solo saxigeno in planitiebus sterilibus serpentinis prope Sanctam Claram, in provincia "Las Villas," Cuba, 24 Mar., 1949.

Thallus extensive, much branched, bearing occasional irregular swellings and rarely very large (35–40 $\mu$   $\times$  18–25 $\mu$ ) setigerous 1- or 2-celled turbinate organs. Sporangia at the tips of more or less elongated branches, rarely intercalary, predominantly spherical and 13–20 $\mu$  in diameter or somewhat pyriform, often apophysate; the wall bearing a variable number of somewhat thickened flexuous setae, 9–16 $\mu$  long. Zoospores slightly ovoid, 5 by 3 $\mu$  with a single hyaline globule and posterior flagellum; emerging through a lateral or subbasal slightly elevated pore upon the dehiscence of an operculum 8 $\mu$  in diameter and remaining in a compact quiescent group before assuming motility. Resting spore not observed.

Saprophytic on cellophane, in soil from serpentine savanna country 2 miles west of Santa Clara, Las Villas Province, Cuba, March 24, 1949.

This species is distinct from all others of the genus in having setae on the sporangia and turbinate cells (Figs. 25, 26).

*Blastocladopsis*, gen. nov.

Thallus filamentosus absque cellula basali definita, usque ad originem partium sexualium non septatus, ad substrato adfixus a rhizoideis crassis. Zoosporangia irregularia vel subcylindrica; papillis emittentibus 1–6. Zoosporae postice uniflagellatae, globulis oleiferis pluribus et nucleo galericulato praeditae. Sporae durantes plerumque globulares vel interdum subellipsoidales, singulatim et mobiliter contentae, membrana aurea, laevi, non punctata circumdatae, demum germinatione fractae et zoosporas per poros paucos postice flagellatas emittentes. Gametophyton ignotum.

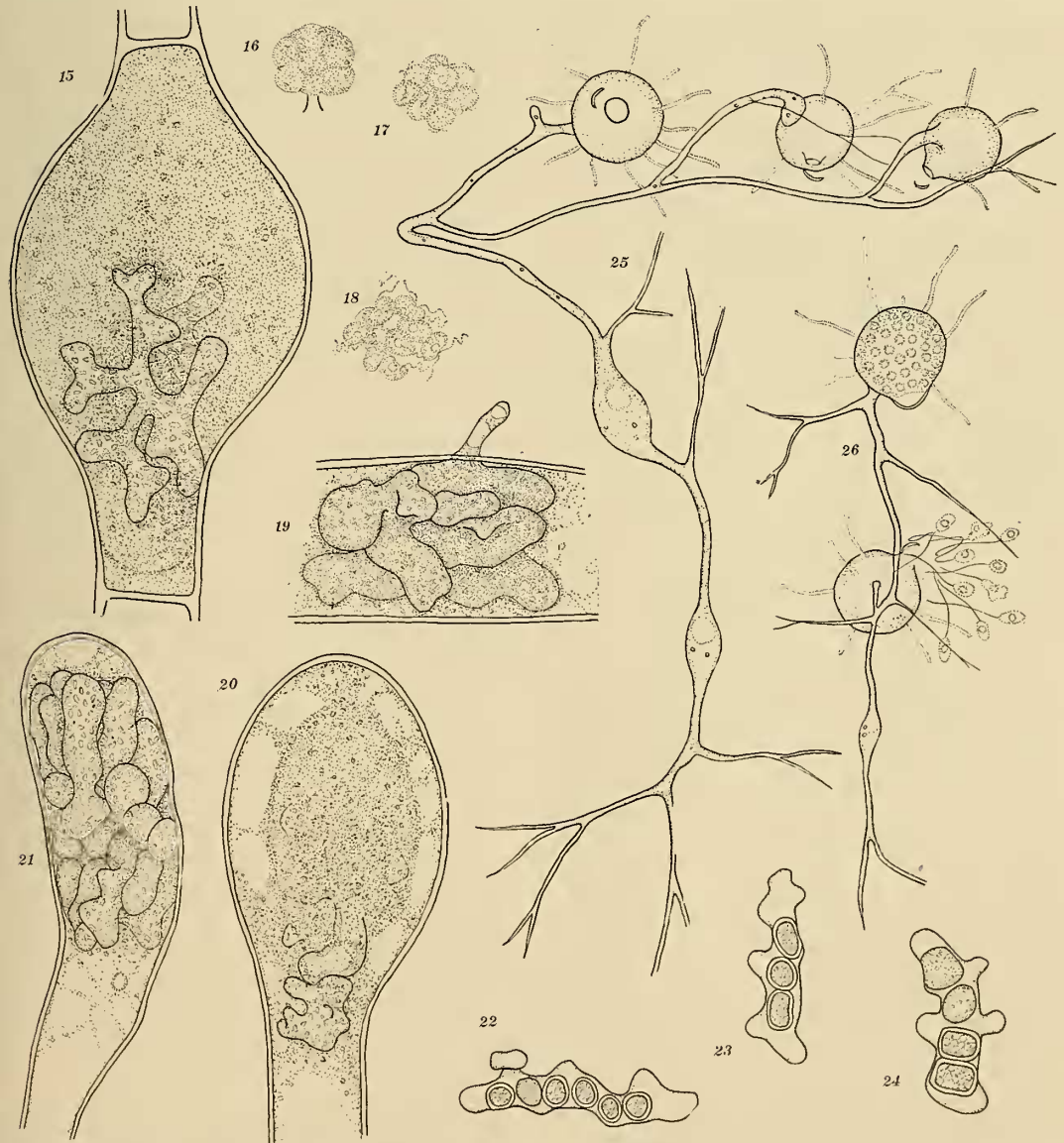
Thallus filamentous, without a well-defined basal cell; nonseptate except where reproductive organs are delimited; dichotomously or subdichotomously branched; anchored to the substratum by a system of coarse-branched rhizoids. Zoosporangia irregular or somewhat cylindrical, with 1–6 discharge papillae. Zoospores posteriorly uniflagellate, with several oil globules and a conspicuous nuclear cap. Resting spores usually spherical or somewhat ellipsoidal, with a thin, golden to amber-colored smooth, nonpunctate wall; borne singly and loosely within their container; upon germination cracking open and discharging posteriorly uniflagellate zoospores through one or more pores. Gametophyte unknown.

*Blastocladiopsis parva* (Whiffen), comb. nov.

*Blastocladia parva* Whiffen, Journ. Elisha Mitchell Sci. Soc. 59: 40. 1943.

Thallus 300 $\mu$  or more in length, unbranched or more commonly dichotomously or subdichotomously branched; hyphae 12–50 $\mu$  in diameter, somewhat irregular. Zoosporangia rare, terminal

on the hyphae, irregular or somewhat cylindrical, 40 by 65.6 to 41.3 by 90.2 $\mu$ , with 1–6 discharge papillae. Resting spores lying loosely in a smooth-walled or occasionally apically papillate container, spherical, ellipsoidal or ovoid, 36.8 by 41 $\mu$  to 35.2 by 77.1 $\mu$ , with a pale amber colored smooth, non-punctate wall; upon germination the wall cracking open and posteriorly uniflagel-



FIGS. 15-26.—15-24, *Lagenidium destruens*, sp. nov.: 15, Young thallus in hypertrophied, walled-off part of *Achlya* hypha; 16-18, stages in formation of zoospores at mouth of discharge tube; 19, mature sporangium with discharge tube penetrating wall of host hypha; 20, 21, thalli in hyphae of host; 22-24, small thalli bearing resting spores. 25, 26, *Nowakowskiella atkinsii*, sp. nov.: 25, Thallus bearing three zoosporangia; 26, portion of thallus bearing a mature sporangium and one discharging its zoospores. (Figs. 15, 20, 21,  $\times 225$ ; Figs. 16-24,  $\times 330$ ; Figs. 25, 26,  $\times 650$ .)

late zoospores escaping through one or two discharge pores.

Saprophytic on snakeskin used as bait, in soil from a tomato field, 3 miles east of Santo Domingo; grass leaves used as bait, in soil from rocky field, 4.5 miles east of Santo Domingo; snakeskin bait, in soil from edge of canefield 7.8 miles north of Cienfuegos on Palmira road; Las Villas Province, Cuba, April 15, 1949.

The above description includes the measurements given by Miss Whiffen from her Texan material. In the Cuban fungi the very rarely formed zoosporangia (Fig. 30) ranged from 55 to 70 $\mu$  in length by 22 to 25 $\mu$  in greatest diameter and formed a lateral as well as an apical discharge pore. Occasionally, the container of the resting spore bore an apical papilla (Fig. 27).

Although *Blastocladiopsis parva* approaches in thallus structure (Fig. 29) certain species of *Blastocladia*, it is distinct from members of that genus in several particulars. The resting spores are completely smooth walled and do not possess the characteristic punctations found in species of *Blastocladia*. Furthermore, the spores lie loosely in their containers rather than filling them as in *Blastocladia*, and, lastly, the zoosporangia form up to six discharge tubes rather than a single apical one. Other features such as the formation of dwarf thalli (Fig. 28), rapidity of development, etc., will be discussed in another paper.

#### *Aphanodictyon* Huneycutt

Mycelium of limited extent, composed of delicate, moderately branched hyphae; gemmae not observed. Zoosporangia borne at the tips of lateral branches of the hyphae, rarely intercalary; wall of the zoosporangium evanescent; the zoospores encysting in position within the sporangium each later emerging through a pore from its cyst, the cysts remaining clustered at the hyphal tip; zoospores of the laterally biflagellate type. Oogonia terminal, bearing 3-5 eggs; walls unpitted. Antheridia present and functional. Oospores with eccentric globules; germinating by a hypha terminating in a sporangium.

#### *Aphanodictyon papillatum* Huneycutt

*Aphanodictyon papillatum* Huneycutt, Journ. Elisha Mitchell Sci. Soc. 64: 279, 1948.

Mycelium delicate; hyphae sparingly branched, the main components about 5 $\mu$  in diameter. Zoosporangia clavate, occasionally nearly cylindrical, terminal on lateral branches along the hypha, rarely intercalary, 13-70 $\mu$  long by

12-18 $\mu$  in greatest diameter, forming a false net after emergence of the zoospores; the zoospores reniform, 6-9 $\mu$  by 4-7 $\mu$ , with granular contents. Oogonia at first spherical, becoming irregular in shape at maturity; bearing numerous broad papillae; wall unpitted; bearing 3-5 somewhat spherical eggs 18-25 $\mu$  in greatest diameter. Antheridia androgynous or occasionally diclinous as well, one or two on an oogonium. Oospores irregularly spherical 18-25 $\mu$  in diameter with a thickened wall and eccentric globule; germinating soon after formation by a hypha which terminates in a zoosporangium.

Saprophytic on snake skin bait in soil from the finca "La Esperanza," Palmas, Matanzas Province, Cuba (coll. Angel Valiente), April 17, 1949.

*Aphanodictyon* is distinct from all Saprolegniaceae with spores encysting within the sporangium in the great delicacy of its vegetative growth, the mycelial mass being barely visible to the naked eye. Furthermore, the zoosporangia (Figs. 8, 9) are borne on short lateral branches along the delicate main hyphae and do not terminate the hyphae or renew growth by cymose branching as in related genera. The sexual apparatus (Fig. 10-14) resembles that of *Thraustotheca*, especially *T. primoachlya* Coker and Couch. Since the species has been reported only once, it seemed desirable to include a rather complete diagnosis. The Cuban material differs significantly from Huneycutt's in having moderately rather than excessively thick oospore walls.

#### *Lagenidium destruens*, sp. nov.

Thallus irregulariter dactylomorphus ramis variabilibus brevibus in plexum contortis interdum plenas partes hospitis infectas valde hypertrophas implens, sporangium unicum proveniens. Zoosporae numerosae reniformes, 12 $\mu$  longae, 8 $\mu$  crassae, lateraliter biflagellatae per tubam ex hospite extrusae ut massa amorphae, demum maturantes. Sporae durante non sexualiter derivatae seriatis in thalli ramis, subrectangulares vel subellipsoidales, 10-15 $\mu$  longae, 8-12 $\mu$  crassae, globulos olei numerosos ferentes; membrana crassa. Germination nondum observata.

Parasiticum in hyphis et partibus reproductivis Achlyae sp. in solo sterili ex saxo serpentino derivatum in planitiebus prope portum navium aeriarum oppidi Sanctae Clarae, in provincia "Las Villas," Cuba, 24 Mar., 1949.

Thallus consisting of a complex of short, finger-like irregular and contorted branches of variable size which may fill the strongly hypertrophied

host parts; forming a single zoosporangium. Zoospores variable in number, reniform, 12 by  $8\mu$ , laterally biflagellate, ejected in an amorphous mass from the discharge tube to the outside of the host where maturation is completed. Resting spores asexually formed in a series in branches of the thallus, rectangular or somewhat ellipsoidal, 10–15 by 8–12 $\mu$ , bearing numerous oil globules; wall thickened; germination not observed.

Parasitic in hyphae and reproductive organs of *Achlya* sp., in soil from serpentine savanna country just west of the Santa Clara airport, Las Villas Province, Cuba, March 24, 1949.

This species is remarkable for its virulence as a parasite. All parts of the host were invaded and destroyed within a few days. Both zoosporangia (Fig. 19) and resting spores (Figs. 22–24) were formed almost simultaneously.

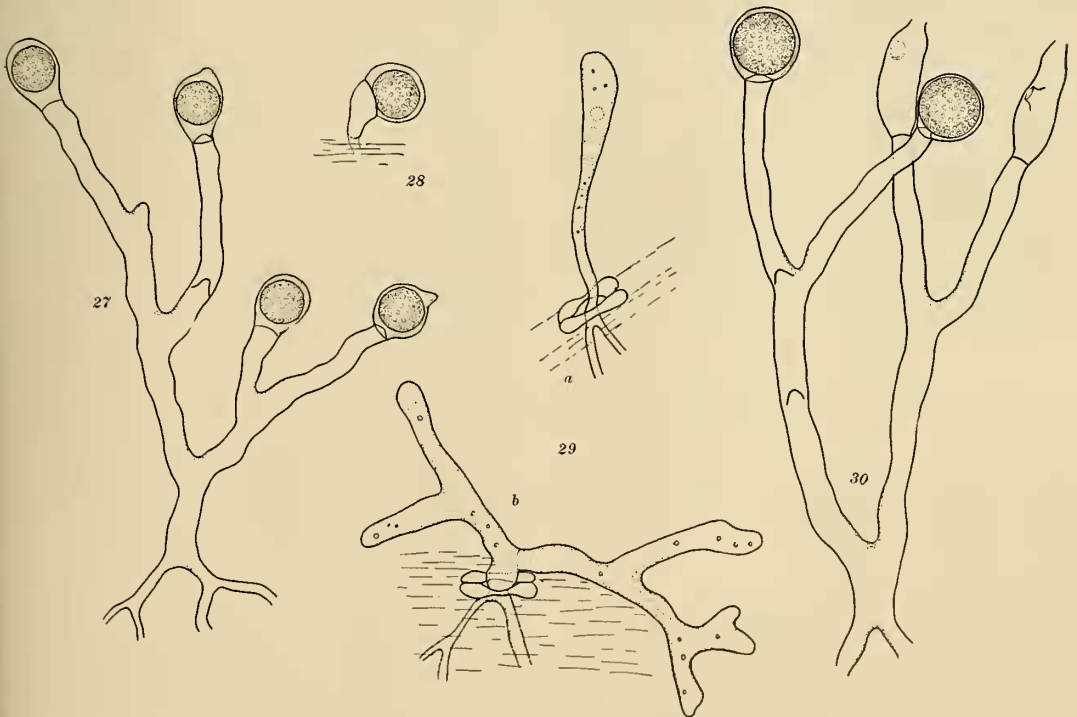
In early stages of thallus development pronounced hypertrophy of the host is evident even though the parasite itself may be wholly or par-

tially masked by the dense contents of the infected part (Figs. 15, 20, 21). Cross walls may or may not be laid down by the host to wall off infected areas. Thalli converted into zoosporangia discharge their contents through a short tube to the outside where the mass, apparently without an enveloping vesicle, rapidly becomes converted into biflagellate zoospores (Figs. 16–18). Other thalli by cleavage of their protoplasm into uniform sized irregular blocks produce asexually the thick-walled resting spores which undoubtedly survive during periods of drought.

*L. destruens* differs from all other 1-celled, saccate species of the genus in the extraordinary complexity of thallus development, resting spores and fungus host.

#### REFERENCE

COUCH, JOHN N. *Technic for collection, isolation, and culture of chytrids.* Journ. Elisha Mitchell Sci. Soc. 55: 208–214. 1939.



FIGS. 27–30.—*Blastocladopsis parva*, comb. nov.: 27, Plant bearing papillate resting spore containers (note suppressed branches); 28, dwarf plant consisting of a few rhizoids in substratum a short basal cell and single resting spore; 29a, young plant emerging through stoma of grass substratum; 29b, older plant; 30, thallus bearing two resting spores and two cylindrical sporangia, each with two discharge pores. (All  $\times 225$ .)